

Appl. No. 10/009,910
Amdt. Dated August 6, 2003
Reply to Office Action of May 9, 2003

Attorney Docket No. 81839.0107

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(12)

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Original): A method for producing a silicon single crystal, wherein the silicon single crystal is pulled while doping with carbon and controlling V/G (V: crystal pulling rate, G: crystal solid-liquid interface temperature gradient along a growing axis) to have an N-region over an entire plane of the crystal in which the silicon single crystal is grown in accordance with Czochralski method.

Claim 2 (Original): The method for producing a silicon single crystal according to claim 1, wherein the silicon single crystal is doped with nitrogen as well as carbon in which CZ silicon single crystal is grown.

Claim 3 (Previously Presented): The method for producing a silicon single crystal according to claim 1, wherein the silicon single crystal is pulled while doping with carbon having concentration of 0.1 ppma or more and controlling V/G within a range of 0.183 to 0.177 mm²/K·min.

Claim 4 (Previously Presented): The method for producing a silicon single crystal according to claim 2, wherein a silicon single crystal is pulled while doping with carbon having concentration of 0.1 ppma or more and controlling V/G within a range of 0.183 to 0.177 mm²/K·min.

Claim 5 (Previously Presented): A method for producing a silicon single crystal, wherein the silicon single crystal produced by the method according to claim 1 is processed into wafers, and the wafers are subjected to heat treatment at a temperature of 600 to 1000°C.

Claim 6 (Previously Presented): A method for producing a silicon single crystal, wherein the silicon single crystal produced by the method according to claim 2 is processed into wafers, and the wafers are subjected to heat treatment at a temperature of 600 to 1000°C.

Claim 7 (Previously Presented): A method for producing a silicon single crystal, wherein the silicon single crystal produced by the method according to claim 3 is processed into wafers, and the wafers are subjected to heat treatment at a temperature of 600 to 1000°C.

Claim 8 (Previously Presented): A method for producing a silicon single crystal, wherein the silicon single crystal produced by the method according to claim 4 is processed into wafers, and the wafers are subjected to heat treatment at a temperature of 600 to 1000°C.

Claim 9 (Original): A silicon wafer, which contains carbon of 0.1 ppma or more and has an N-region over an entire plane thereof.

Claim 10 (Original): The silicon wafer according to claim 9, which contains nitrogen of 1×10^{13} number/cm³ or more.

Claim 11 (Previously Presented): A method for producing a silicon epitaxial wafer formed an epitaxial layer on a surface of a silicon wafer produced from a CZ silicon single crystal pulled with doping with carbon and nitrogen in which the CZ silicon single crystal is grown, wherein the CZ silicon single crystal is pulled to have carbon concentration, nitrogen concentration and oxygen concentration of 0.1 to 1 ppma, 1×10^{13} to 1×10^{14} number/cm³ and 15 to 25 ppma, respectively, or 1 to 3 ppma, 1×10^{14} to 5×10^{15} number/cm³ and 10 to 15 ppma, respectively.

Claim 12 (Original): The method for producing a silicon epitaxial wafer according to claim 11, wherein the CZ silicon single crystal is pulled not to generate secondary defects.

Claim 13 (Previously Presented): A silicon epitaxial wafer formed an epitaxial layer on a surface of a silicon wafer produced from a CZ silicon single crystal pulled with doping with carbon and nitrogen in which the CZ silicon single crystal is grown, wherein the silicon wafer has carbon concentration, nitrogen concentration and oxygen concentration of 0.1 to 1 ppma, 1×10^{13} to 1×10^{14} atoms/cm³ and 15 to 25 ppma, respectively, or 1 to 3 ppma, 1×10^{14} to 5×10^{15} atoms/cm³ and 10 to 15 ppma, respectively.

Claim 14 (Original): The silicon epitaxial wafer according to claim 13, wherein a silicon wafer produced from the CZ silicon single crystal pulled with doping with nitrogen has no secondary defects.

Claim 15 (Previously Presented): A method for producing an annealed wafer formed a denuded zone in a surface layer of a CZ silicon wafer and having oxide precipitates of 1×10^9 atoms/cm³ in a bulk portion by performing a heat treatment to the CZ silicon wafer produced from a CZ silicon single crystal pulled with doping with carbon and nitrogen in which the CZ silicon single crystal is grown, wherein the CZ silicon single crystal is pulled to have carbon concentration, nitrogen concentration and oxygen concentration of 0.1 to 1 ppma, 1×10^{13} to 1×10^{14} atoms/cm³ and 15 to 25 ppma, respectively, or 1 to 3 ppma, 1×10^{14} to 5×10^{15} atoms/cm³ and 10 to 15 ppma, respectively.

Claim 16 (Original): The method for producing an annealed wafer according to claim 15, wherein the CZ silicon single crystal is pulled not to generate secondary defects.

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Claim 17 (Previously Presented): An annealed wafer produced by performing a heat treatment to a CZ silicon wafer having carbon concentration, nitrogen concentration and oxygen concentration of 0.1 to 1 ppma, 1×10^{13} to 1×10^{14} atoms/cm³ and 15 to 25 ppma, respectively, or 1 to 3 ppma, 1×10^{14} to 5×10^{15} atoms/cm³ and 10 to 15 ppma, respectively, wherein BMD density in a bulk portion is 1×10^9 atoms/cm³ or more.

Claim 18 (Original): The annealed wafer according to claim 17, wherein the wafer has no secondary defects.